

HL Acid-Base Review (2011 Exam)

Name.....

1. Which mixture would produce a buffer solution when dissolved in 1.0 dm^3 of water?
- 0.50 mol of CH_3COOH and 0.50 mol of NaOH
 - 0.50 mol of CH_3COOH and 0.25 mol of NaOH
 - 0.50 mol of CH_3COOH and 1.00 mol of NaOH
 - 0.50 mol of CH_3COOH and 0.25 mol of $\text{Ba}(\text{OH})_2$

2. The acid dissociation constant of a weak acid HA has a value of $1.0 \times 10^{-5} \text{ mol dm}^{-3}$.
What is the pH of a 0.10 mol dm^{-3} aqueous solution of HA ?
- 2
 - 3
 - 5
 - 6

3. An aqueous solution has a pH of 10. Which concentrations are correct for the ions below?

	$[\text{H}^+(\text{aq})] \text{ mol dm}^{-3}$	$[\text{OH}^-(\text{aq})] \text{ mol dm}^{-3}$
A.	10^4	10^{-10}
B.	10^{-4}	10^{-10}
C.	10^{-10}	10^{-4}
D.	10^{-10}	10^{-4}

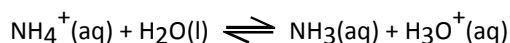
4. Which is the correct statement about the pH and pOH values of an aqueous solution at 25°C ?
- $\text{pH} + \text{pOH} = 14.0$
 - $\text{pH} + \text{pOH} = 1.0 \times 10^{-14}$
 - $\text{pH} \times \text{pOH} = 14.0$
 - $\text{pH} \times \text{pOH} = 1.0 \times 10^{-14}$
5. Which compound, when dissolved in aqueous solution, has the highest pH?
- NaCl
 - Na_2CO_3
 - NH_4Cl
 - NH_4NO_3

6. The strengths of organic acids can be compared using K_a and $\text{p}K_a$ values. Which acid is the strongest?

A.	Acid A	$\text{p}K_a = 6$
B.	Acid B	$\text{p}K_a = 3$
C.	Acid C	$K_a = 1 \times 10^{-5}$
D.	Acid D	$K_a = 1 \times 10^{-4}$

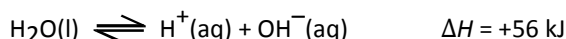
7. Which salt, when dissolved in water to form a 1.0 mol dm^{-3} solution, produces the lowest pH value?
- Ammonium chloride
 - Ammonium ethanoate
 - Sodium ethanoate
 - Sodium chloride

8. Ammonia (NH_3) is a weak base in aqueous solution with an ionization constant K_b . What expression is equal to the ionization constant for the following reaction?



- A. $\frac{K_w}{K_a}$
B. $\frac{K_a}{K_w}$
C. $\frac{K_w}{K_b}$
D. $\frac{K_b}{K_w}$

9. Water dissociates according to the equation



At 25°C water has a pH of 7. Which of the following occurs when water is heated to 30°C ?

- A. It remains neutral and its pH decreases.
B. It becomes acidic and its pH decreases.
C. It remains neutral and its pH increases.
D. It becomes acidic and its pH increases.

10. The $\text{p}K_a$ values of four acids are as follows.

W	4.87
X	4.82
Y	4.86
Z	4.85

What is the correct order when these acids are arranged in order of **increasing** acid strength?

- A. X, Z, Y, W
B. X, Y, Z, W
C. W, Z, Y, X
D. W, Y, Z, X
11. 10 cm^3 of 0.01 mol dm^{-3} nitric acid (HNO_3) is diluted with 90 cm^3 of water. What is the pH of the resulting solution?
- A. 1
B. 2
C. 3
D. 4
12. What is the value of $[\text{H}^+]$ in a buffer solution in which $[\text{CH}_3\text{COOH}] = 2.0 \text{ mol dm}^{-3}$ and $[\text{CH}_3\text{COO}^-] = 1.0 \text{ mol dm}^{-3}$?
For CH_3COOH , $K_a = 1.8 \times 10^{-5} \text{ mol dm}^{-3}$.
- A. 6.0×10^{-3}
B. 3.6×10^{-5}
C. 1.8×10^{-5}
D. 9.1×10^{-6}
13. Which salt forms the most acidic solution when added to water?
- A. NaCl
B. MgSO_4
C. $\text{Al}(\text{NO}_3)_3$
D. KHCO_3

(Total 1 mark)

14. Which values are correct for a $0.010 \text{ mol dm}^{-3}$ solution of NaOH(aq) at 298 K?

($K_W = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ at 298 K)

- A. $[\text{H}^+] = 1.0 \times 10^{-12} \text{ mol dm}^{-3}$ and $\text{pH} = 12.00$
B. $[\text{OH}^-] = 1.0 \times 10^{-12} \text{ mol dm}^{-3}$ and $\text{pH} = 12.00$
C. $[\text{H}^+] = 1.0 \times 10^{-12} \text{ mol dm}^{-3}$ and $\text{pOH} = 12.00$
D. $[\text{OH}^-] = 1.0 \times 10^{-12} \text{ mol dm}^{-3}$ and $\text{pOH} = 12.00$

15. At 25°C , K_a for an acid is 1.0×10^{-2} . What is the value of K_b for its conjugate base?

- A. 1.0×10^2
B. 1.0×10^{-2}
C. 1.0×10^{12}
D. 1.0×10^{-12}

16. The formula and $\text{p}K_a$ value of chloroethanoic acid appear in Table 16 of the Data Booklet. Use this information to answer the following questions.

(a) Write the equation for the dissociation of chloroethanoic acid in aqueous solution.

.....

(1)

(b) Deduce the K_a expression for the dissociation.

.....

.....

(1)

(c) Calculate the value of K_a for chloroethanoic acid.

.....

(1)

(d) Arrange the following acids in increasing order of acid strength (starting with the weakest).

(1)

chloroethanoic acid

ethanoic acid

iodoethanoic acid

Order

(Total 4 marks)

17. Predict whether each of the following solutions would be acidic, alkaline or neutral. In each case explain your reasoning.

(i) $0.1 \text{ mol dm}^{-3} \text{ FeCl}_3(\text{aq})$

.....

.....

.....

(ii) $0.1 \text{ mol dm}^{-3} \text{ NaNO}_3(\text{aq})$

.....

.....

.....

(iii) $0.1 \text{ mol dm}^{-3} \text{ Na}_2\text{CO}_3(\text{aq})$

.....

.....

.....

(Total 6 marks)

18. State and explain whether each of the following solutions will form a buffer solution.

- (i) A 1.0 dm^3 solution containing 0.10 mol NH_3 and 0.20 mol HCl

.....
.....
.....
.....
.....

(2)

- (ii) A 1.0 dm^3 solution containing 0.20 mol NH_3 and 0.10 mol HCl

.....
.....
.....
.....

(2)

(Total 4 marks)

19. (a) (i) Calculate the K_a value of methanoic acid, HCOOH , using table 16 in the Data Booklet.

.....
.....

(1)

- (ii) Based on its K_a value, state and explain whether methanoic acid is a strong or weak acid.

.....
.....
.....
.....

(2)

- (iii) Calculate the hydrogen ion concentration and the pH of a $0.010 \text{ mol dm}^{-3}$ methanoic acid solution. State **one** assumption made in arriving at your answer.

(4)

.....
.....
.....
.....
.....
.....
.....

- (b) Explain how you would prepare a buffer solution of pH 3.75 starting with methanoic acid.

.....
.....
.....
.....
.....
.....

(3)

(Total 10 marks)

20. The value of the ionic product constant of water, K_W , at 60°C is $5.60 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$.

(a) State the expression for K_W .

.....

(1)

(b) Calculate the values of $[\text{H}^+]$ and pH in water at 60°C.

.....
.....
.....
.....
.....

(3)

(c) The value of $[\text{OH}^-]$ in water at 60°C is greater than the value at room temperature. Explain why water is not alkaline at 60°C.

.....
.....

(1)

(Total 5 marks)

21. An experiment was carried out to determine the concentration of an aqueous solution of ammonia by titrating it with a solution of sulfuric acid of concentration $0.150 \text{ mol dm}^{-3}$. It was found that 25.0 cm^3 of the ammonia solution required 20.1 cm^3 of the sulfuric acid solution for neutralization.

(a) Write the equation for the reaction and calculate the concentration, in mol dm^{-3} , of the ammonia solution.

.....
.....
.....
.....
.....

(4)

(b) Determine the pOH of a solution with an ammonia concentration of $0.121 \text{ mol dm}^{-3}$. ($\text{p}K_b$ of ammonia is 4.75.)

.....
.....
.....
.....
.....
.....
.....

(4)

(Total 8 marks)